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ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

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THOMAS V. SKINNER, DIRECTOR

217.782.6762

August 31, 2000

Mr. Kevin Turner
U.S. EPA
c/o Crab Orchard National Wildlife Refuge
8588 Route 148
Marion, IL 62959

Reference: 1630200005 St.Clair County
Sauget Area 1 Site
Superfund/Technical
Time Critical Removal Action Draft Work Plan dated June 30, 2000
Administrative Order dated May 31, 2000; Docket No.: V-W-99-C-554

Dear Mr. Turner:

The purpose of this letter is to provide you with a paper version of Rob Watson's reviewer's comments on the referenced project. It is my understanding that Rob sent an electronic version of his comments to you, Mike McAteer, and Mike Light, and that you should receive that version today.

If you have any questions, please call me at 217.785.9397 or Rob at 217.524.3265.

Sincerely,

Candy Morin

Candy Morin, Remedial Project Manager
National Priorities List Unit
Federal Site Remediation Section
Division of Remediation Management
Bureau of Land

Enclosure

cc w/enclosure: Mike McAteer, EPA Region V
W. Rob Watson, IEPA
Mike Henry, IDNR
Denise Stoeckel, IDNR
Kevin de la Bruere, USFWS

sgtarea1/wrwrawp08.00

1630200005 – St. Clair County
Sauget Area 1, Dead Creek
Sediment Containment Cell
Superfund/Technical File

Reviewer: Rob Watson

The following are my comments on the Time Critical Removal Work Plan, Dead Creek Sediment and Soil in Sauget and Cahokia, Illinois dated June 30, 2000. The primary focus of my review was the Containment Cell Design Report in Appendix 7.

General

1. Response to Comments: The response to these comments needs to include a list of item-by-item responses that indicates how each comment was addressed and where the Design Report was revised in response to each comment.

2. Format of Design Report and Requirements in Exhibit 2: In order to demonstrate that all of the requirements in Exhibit 2 of the UAO are met, the Design Report needs to include a table that clearly cross references the requirements in Exhibit 2 with the various Sections, and appendices in Appendix 7.

3. Figures in Appendix 7: If the Figures after 5-6 are redundant/extras, they should be removed from the report. If they refer to specific design issues not shown in the other figures, they need to be specifically referenced in the narrative portion of the design report.

4. Previous Excavation of the Site: Section 4.2.1 includes the statement "portions of the site have apparently been previously excavated for borrow material." These excavated areas need to be identified on a scale topographic map of the site. The document needs to indicate if these excavated areas were filled in. If they were backfilled, the fill material needs to be identified and possibly sampled to determine its chemical and engineering properties.

Liner System Description

5. Section 4.1.1, Liner System Description: The document needs to identify the manufacture, product name, and include technical data sheets for all components proposed for use in the bottom, side, and cover systems. Wording which will allow the use of materials from a different manufacturer can also be included in the document provided the alternate material has equivalent, or better, characteristics/properties to the one identified in the Design Report.

6. Section 4.1.1, Liner System Description: A geotextile needs to be placed between the capillary break layer (gravel) and subgrade for the GCL. The geotextile needs to be thick enough (and strong enough) to prevent the six-inch fill layer from being pushed down into the gravel. The document needs to provide the manufacturer, product name, and specifications of this geotextile. It also needs to compare these specifications to the

conditions it will be exposed to in the liner system and demonstrate the geotextile will function as intended.

7. Section 4.1.1, Liner System Description: Uncompacted native fill or sand (in the case of the cover system) will not form an adequate subgrade for the GCL. The subgrade under the GCLs in the bottom liner, on the side slopes, and in the cover system all need to be constructed of soils that can be formed into bedding layers capable of supporting and protecting the GCL and other layers in the liner system during the construction process. For more specific requirements regarding the density, moisture, and gradation specifications required for the GCL bedding layer, refer to the comments on the Earthwork Specification 02200 in Appendix E.

8. Section 4.3.1, Synthetic Liners: The description of the HDPE geomembrane states that it will be smooth (not textured). It is recommended that a textured geomembrane be used to improve the structural stability of the liner systems. If the geomembrane will be textured, the asperity height (height of the textured surface) also needs to be indicated.

9. Section 4.1.1, Synthetic Liners: The design report needs to demonstrate that the 12 inch soil layer in the primary liner system will meet the HDPE geomembrane manufacturer's bedding layer specifications. As part of this demonstration, the design report needs to identify the soil type and grain size distribution of this 12-inch soil layer. This layer should be a clayey soil compacted to at least 95% of the Standard Proctor Density using ASTM D-689 and have a moisture content at or wet of optimum.

10. Section 4.1.1, Synthetic Liners: The description of the primary liner states that the 12-inch soil layer will not be installed on the side slopes. The design report needs to indicate why the design on the side slopes is different from the bottom liner design and provide justification for this design change. It is recommended that the clay layer in the primary liner system continue up the side slope.

11. Section 4.1.1, Synthetic Liners: The narrative states (and Figure 4-2 shows) that wastes will be placed directly on top of drainage composite on the side slopes. This is significantly different from the design of the leachate collection system on the bottom liner. The design report needs to indicate why the design of the leachate collection system on the side slopes is different from the bottom liner design and provide justification for this design change. The 6-inch sand protective layer over the geotextile needs to continue up the side slopes.

12. Section 4.1.2, Liner System relative to High Water Table: The report needs to include a geologic cross section that shows the elevations of the landfill, the formations under the unit, and the seasonal fluctuations in the water table.

13. Section 4.1.3, Loads on the Liner System: Calculations supporting the statements and conclusions need to be included in the design report and referenced in the narrative of Section 4.1.3. Each layer in the liner system needs to be considered in the calculations, not just the HDPE geomembrane.

14. Section 4.1.4, Figure 4-7, Liner system Anchor Detail: The design report needs to justify the design of the anchor shown in Figure 4-7. The report needs to include estimates of the forces the landfill will exert on the liners, and calculations that show that the anchor will hold the liner in place.

15. Section 4.1.5, Liner System Exposure Prevention: Section 4.1.5 of Appendix 7 in the design report does describe how the liner system (especially the geomembrane layers) will be protected from the wind. This can either be done by placing the soil/sand layers on the geomembrane quickly (e.g. same day) after it is installed, or by temporarily placing sand bags on it.

16. Section 4.1.5, Liner System Exposure Prevention: Section 4.1.5 of Appendix 7 in the design report needs to discuss the problems associated exposing the GCL to moisture and describe how the GCL will be protected from hydrating before a uniform confining weight (e.g. 6 inches of soil) can be placed on it. Specifically, if the GCL is allowed to hydrate (e.g. swell) without any weight on it, it will lose its structural integrity and need to be replaced. To prevent this problem, the design report needs to indicate that two things will be done. First, each GCL panel (in the bottom, sides, and cover systems) needs to be covered with the geomembrane the same day the GCL is installed to protect it from precipitation and moisture in the air.

    Second, even after the GCL is protected from precipitation by the geomembrane, it will continue to hydrate by drawing moisture from the underlying soil in the subgrade. Therefore, at least 6 inches of soil/sand need to be placed on the GCL to provide uniform confining pressure on it before it is allowed to hydrate beyond 100%. The document needs to provide an estimate of how long it will take the GCL to hydrate to 100% (along with the justifications for this estimate), and show that the construction schedule will be sufficient to insure that adequate confining weight is placed on the GCL within this timeframe.

FOUNDATION

17. Section 3.0, Site Characterization: The proposed location of the containment cell needs to be shown relative to the borings on Figure 3-1.

18. Section 3.0, Site Characterization: Geologic cross sections from the surface down to the confining layer (bedrock) need to be provided. The location and elevations of the proposed containment cell needs to be shown on these cross sections.

19. Section 3.0, Site Characterization: Piezometer PZ-1, and the three GB borings, all end in the sand layer (either SM or SP). None of the borings continues to the top of a confining layer (which may be bedrock at this site). The design report needs to characterize the geology from the surface down to the first confining layer. This requirement can be met by either providing a the boring log report for an existing boring near the site that extends down to a confining layer, or by installing an additional boring at the site that extends a confining layer.

20. Section 3 and Appendix A in Appendix 7, Laboratory Test Data: The following test results and information regarding the soils under the site need to be provided:

   a. Unconfined compression test results (shear strengths) for the upper clay layer, the loose sand layer, and the dense sand layer under the site.

   b. Consolidation test results for the upper clay layer, the loose sand layer, and the dense sand layer under the site.

   c. Hydraulic conductivity test results for all soil strata under the site (the upper clay layer, the silt layer, the loose sand layer, and the dense sand layer).

   d. The ASTM, EPA or other appropriate standard methods used to perform the tests needs to be identified in the document.

ENGINEERING ANALYSES

21. Section 4.2.1, Settlement Potential: The assumptions used to calculate differential settlement are not acceptable. The settlement under the landfill needs to be recalculated considering the following comments:

   a. Density and Soil Strata: The calculations assume a single density for the soil and then assume it is equal to the density of the waste. There are four different soil strata under the site. The calculations need to account for the characteristics of each soil strata and each of the material that is in the liner system. In addition, the calculations need to account for the weight of the gravel or the liner materials. Finally, the actual density (and moisture content) of the sediments needs to be determined and used in the calculations.

   b. Base Elevations: The calculations assume an initial flat surface elevation. However, the narrative states the initial elevation of the site varies by 10 feet. The calculations need to account for the change in elevation across the landfill. This is especially true if the elevation change is because the surface layer (such as the clay) was removed from a portion of the site.

   c. Settlement of Berms: The settlement calculations consider the embankment and fill areas separately. However, the discussion and calculations on differential settlement need to clarify the way the entire landfill is expected to settle during both its construction and later after it is covered. Placement of wastes and the cover system on the interior slopes of the berms could also result in some amount of settlement under the berms. Therefore, the settlement calculations for the embankments need to be provided for the conditions both before, and after, the liner and waste are placed in the landfill. Finally, the design report needs to discuss how settlement of the berm relative to settlement the waste and liner system will impact the stresses placed on the components in the liner system.

   d. Maximum Differential Settlement: The calculations assume an average fill height, that the maximum settlement will occur in the middle of the landfill, and that the settlement at the edge is 2/3 of the settlement in the middle. Differential settlement calculations need to consider the maximum elevation of the landfill, where the maximum settlement is anticipated, and compare this to the location where the least amount of settlement will occur. Figure 5-2 shows the maximum elevation (~ 427') occurs in the southwest quadrant, not the middle of the landfill. The settlement under the maximum elevation needs to be compared to the settlement calculated under the sump area in the northeast corner. This comparison should give not only the maximum differential settlement, but also identify if settlement will negatively impact the bottom slope or leachate collection system.

e. Calculations: The calculations used to estimate the consolidation in the computer model need to be provided with justifications for all assumptions used in the model.

22. Section 4.2.2, Bearing Capacity: Section 4.2.2 states that undrained shear strengths were determined for the surficial clays and silts. However, the test results provided in Appendix B show that clay only made up the top 1 inch (of a 6 inch sample) for one of the three unconfined compression tests. Therefore, this section needs to be revised to reflect that the undrained shear strength is only known for the silts under the site. Conversely, additional testing could be done on the surficial clay to determine its undrained shear strength (this is the preferred option).

23. Section 4.2.2, Bearing Capacity: Section 4.2.2 needs to provide justification for the statement that the limiting bearing capacity strata was found to be the surficial clays and silts. Part of this justification should include providing the test results from all of the soil strata under the proposed landfill site.

24. Section 4.2.3, Containment Cell Slope Stability: The narrative in this section is not adequate to demonstrate the containment cell is designed with an adequate factor of safety against slope failure. The following issues need to be addressed:

a. References to Appendix B: Justifications for the factors of safety discussed in Section 4.2.3 are not provided. If these values are based on the computerized slope stability analyses in Appendix B, the narrative needs to reference this information.

b. Equations and Calculations: All equations and calculations used in the slope stability analyses need to be provided. If a computer program is used, the equations that the program is based upon, the assumptions used for each run, and a copy of the program all need to be provided.

c. Soil Strata Assumptions: The soil borings in Appendix A show clay (CL), silt (ML) and loose sand (SM) are present from the ground surface down to approximately 10 feet. However, the total Unit Weight and Saturated Unit Weight were assumed to be the same for each soil type modeled in each computer run in Appendix B. The document needs to justify assigning the same values to different soil types (e.g. provide soil analyses or refer to test results provided elsewhere in the document).

d. Friction Angles: The slope stability evaluation needs to calculate the required interface angle that satisfies the required factor of safety (FS) $\geq$ 1.5 (or as specified in the regulations). This needs to be done for the berms (both interior and exterior slopes), all interfaces in the liner system, and the cover system. When the liner materials are delivered to the site they need to be tested to verify the required friction angles are achieved. In the case of the soils in the liner and berms, once they are compacted, they too need to be tested to verify the required friction angles are achieved.

e. Interface Friction Angle: This section assumes an interface friction angle of 11 degrees between the geonet drainage material and the HDPE liner. The data and justification for this assumption need to be provided.

f. Worst Case Interface: The document needs to include an evaluation of the interface friction angle between all interfaces in the liner (bottom, side, and cover) systems. Part of this evaluation must be the identification, and justification, of the two materials determined to have the worst-case interface friction angle. When an interface involving a GCL is investigated, the evaluation must consider the GCL is hydrated to at least 100% and discuss bentonite migration in the GCL.

g. Laboratory Testing of Liner Materials: The interface friction angles between the various layers in the liner systems (bottom, side, and cover) should be determined in the lab using a shear box (ASTM D5321-92), a large scale direct shear box (ASTM D5321), or a ring shear device (ASTM draft method). If an alternate method is proposed, the document must provide justification for this method.

25. Section 4.2.6, Potential for Excess Hydrostatic or Gas Pressure: The design report needs to include calculations demonstrate that the weight of the completed landfill will be greater than the hydrostatic uplift pressure.

SYNTHETIC LINERS

26. Section 7 Material Compatibility Studies: This section needs to indicate the approximate date the compatibility testing will be concluded and results provided to USEPA and IEPA.

27. Section 4.3.2, Synthetic Liner Strength: Section 4.3.2 makes a number of statements regarding the strength of the liner that are not justified in the narrative. The narrative needs to provide specific numbers and refer to specific calculations (not just the Appendix) and technical data sheets on the materials in order to justify conclusions such as the following:

- The synthetic linings in the containment cell will not be subject to significant tensile stresses.
- The side slope linings will not be overstressed.
- The longitudinal seams are not expected to be significantly loaded.
- The strain in the bottom lining due to settlement is well within the elastic limit for the HDPE lining.
- It appears the bottom linings will not be overstressed.

28. Appendix C, Calculations on Lining Tensile Strength: The calculations need to be revised as necessary to address the following comments and provide justifications for the assumptions:

    a. The overburden stress should be calculated using maximum thickness over slope in order to determine the worst-case scenario, not the average.

    b. The calculations need to discuss how the liner's anchor figures into the calculation.

    c. The document needs to provide calculations for all materials in the liner system, not just the HDPE geomembrane.

    d. The justification for the interface friction angle between HDPE & HDPE needs to refer to the 1999 edition of Designing with Geosynthetics.

    e. The document needs to calculate the interface friction angles that satisfy the required factor of safety, and then verify these values are not exceeded by testing in the lab (see above comments on slope stability analysis).

    f. The stresses due to settlement do not appear to be addressed in this calculation. As part of this discussion, the document needs to indicate whether the berms or just the gravel and waste are expected to settle (and how much) after the lining materials are installed.

29. Section 4.3.3, Synthetic Liner Bedding: Section 4.3.3 did not provide any type of demonstration that sufficient bedding will be provided both above and below the synthetic liners to prevent rupture of the synthetic liner during installation and operation (i.e., thickness and gradation).

GCL Liners

30. Appendix C, GCL Load Calculations: The calculations need to be revised as necessary to address the following comments and provide justifications for the assumptions:

    a. The overburden stress should be calculated using maximum thickness over slope in order to determine the worst-case scenario, not the average.

    b. The calculations need to discuss how the GCL's anchor figures into the calculation.

    c. A more detailed description (with calculations as necessary) needs to be provided to justify the statements that the entire downward force (T) must be carried by the internal shear strength of the GCL and that no tension is produced in the GCL.

    d. The document needs to describe how the overburden weight is transferred through the layers of the liner system above the GCL. Is the full tensile force (T) from the overburden weight transferred to the GCL, or was this a worst-case assumption?

e. The calculations cite the CETCO Product Manual, Direct Shear Test Data as a source for an interface friction angle between the GCL and soil of 31°. A note on the cover of this data summary clearly states "This data is for informational purposes only and is not intended to replace project specific interface testing, which CETCO emphatically recommends." Therefore, this source for interface friction angles should not be used for design purposes.

f. The document needs to calculate the interface friction angles that satisfy the required factor of safety, and then verify these values are met by testing in the lab (see above comments on slope stability analysis).

g. The stresses due to settlement do not appear to be addressed in this calculation. As part of this discussion, the document needs to indicate whether the berms or just the gravel and waste are expected to settle (and how much) after the lining materials are installed.

31. Section 4.4.2, GCL Strength: Section 4.4.2 in Appendix 7 (page 4-10) states "all tensile stresses will be transferred through the GCL via the internal shear strength to the underlying soil layers." Appendix C also states that no tension is produced in the GCL. However, the Specification for GCLs (02245) in Appendix E states the minimum friction angle for hydrated GCL on a slope is 6°. This is less than the interface friction angles above (11°) and below (31°) the GCL. Therefore, the GCL will not be strong enough to transfer the tensile force to the soils underneath it.

The conclusions in Section 4.4.2 and the calculations in Appendix C need to be reevaluated and/or additional documentation provided to demonstrate the GCL is strong enough to support the forces exerted on it.

LINER SYSTEM, LEACHATE COLLECTION AND DETECTION SYSTEM:

32. Section 4.5, Leachate Collection System: The leachate collection system needs to be revised to include the following features:

a. The proposal to monitor leachate on a monthly and then annual basis is not adequate to demonstrate that leachate will be removed from the landfill in a timely manner. The leachate collection system needs to include dedicated pumps, sensors, and plumbing to insure that the depth of leachate on top of the primary liner never exceeds one foot. The system pumps need to be automatically actuated by the liquid level in the sump. The system also needs to include a high level alarm to inform Monsanto/Solutia when the liquid level is above the acceptable elevation. The description of the system needs to identify the type of alarm and where the signal will be sent (e.g. the security office at the W.G. Krummrich Plant).

b. Monsanto/Solutia may want to install an actual sump for the leachate collection system instead of just a gravel layer at the bottom of the slope. A sump at a lower elevation than the primary liner system probably will be necessary in order to meet the requirement to maintaining no more than one foot of leachate on the primary liner, and to accommodate the technical requirements for the pumps.

c. The elevation view(s) of the collection sump need to show the elevations at which the pump will turn on, turn off, and when the high level alarm will be actuated.

d. The collection sump should include horizontal perforated pipes to house and protect the suction hoses used to remove leachate.

e. A description of why a perforated instead of solid pipe will extend from the sump to the surface of the landfill. A perforated pipe should not be used outside of the sump because it could become a conduit for waste sediments to get into the sump and clog it.

f. Detailed scale drawings (both plan and elevation views) of the leachate collection system and the leachate collection sump need to be provided.

g. A more detailed description of how liquids will actually be removed from the sump also needs to be provided.

33. <u>Section 4.5, Leachate Detection System</u>: The design report needs to address the following comments regarding the leachate detection system:

a. The design report needs to describe how the detection system will function to detect any leakage through either liner in a timely manner. The proposal to monitor leachate on a monthly and then annual basis is not adequate to make this demonstration. To insure the leachate detection system will detect (and is able to remove) leachate in a timely manner, the system needs to include liquid sensors, level actuated pumps, etc.

b. The detection sump should include horizontal perforated pipes to house and protect the suction hoses used to remove leachate.

c. Detailed scale drawings (both plan and elevation views) of the leachate detection system sump need to be provided.

d. A more detailed description of how liquids will actually be removed from the sump also needs to be provided.

e. The design report should include some discussion of why the leachate collection, detection, and capillary break sumps are located in separate areas instead of a vertical line.

34. <u>Section 4.5, Capillary Break Layer</u>: The design report needs to address the following comments regarding the capillary break layer:

a. Detailed scale drawings (both plan and elevation views) of the capillary break sump need to be provided.

b. A more detailed description of how liquids will actually be removed from the sump also needs to be provided.

c. The capillary break sump should include horizontal perforated pipes to house and protect the suction hoses used to remove leachate.

d. At a minimum, the capillary break layer needs to include sensors and an alarm to inform Monsanto/Solutia when the liquid level in this layer is above a specified elevation. The narrative needs to identify this elevation, and include justification for it. The description of the system needs to identify the types of sensors and alarm, and where the signal will be sent (e.g. the security office at the W.G. Krummrich Plant).

35. Section 4.5.2, Equivalent Capacity: Section 4.5.2 only states that the geonet transmissivity will be greater than 12 inches of sand with a hydraulic conductivity of 1×10^{-2} cm/sec. It needs to refer to copies of manufacture's data sheets provided for the geonet, and calculations that demonstfate this statement is correct.

36. Section 4.5.3, Grading and Drainage: This section needs to include additional detail regarding the grading and drainage for the proposed landfill. Specifically:

a. The description of the leachate collection system needs to include a demonstration of why perforated pipes are not included as part of the lateral leachate collection system on the bottom of the landfill.

b. The narrative needs to discuss how the collected leachate will be disposed. Indicate the appropriate permits which will need to be obtained. As a newly generated waste, Monsanto/Solutia will need to determine if it is a hazardous waste. If it is a hazardous waste, storage of it for greater than 90 days is subject to the RCRA storage requirements.

37. Section 4.5.4, Maximum Leachate Head: This section needs to provide the following information to clarify the conclusions in the document:

a. Cross sections that identify each of the layers in both HELP models.

b. Justifications for the assumptions used in the HELP models. For example, when the amount of leachate the sediments will generate is estimated, the report should include lab data from the field and bench/pilot scale tests regarding the moisture content of the sediments and descriptions the physical processes that will be used to dewater them before they are placed in the landfill.

c. A description of why Layer 6 (waste sediments) is not included in the HELP model for the closed landfill, and why the average head on top of Layer 8 (the primary liner) is indicated to be 0.000 for each year. Thus, it appears the model assumes that all liquids will be squeezed out of the sediments during construction of the landfill, and no precipitation gets through the cover system. The report needs to provide additional discussion and justification for this assumption.

38. Section 4.5.7 Prevention of Clogging: The following information regarding geotextiles needs to be included in the report:

   a. A sieve analysis of the waste material needs to be performed on both the sediments and the soil used in the primary liner system. This data then needs to be compared to the technical data sheet for the GCL. This is necessary in order to demonstrate the weight and apparent size opening (AOS) of the geotextile(s) is adequate for the design and will not clog.

   b. Describe how clogging would be detected and what cleanup procedures would be used to restore the capacity of the systems.

LINER SYSTEM, CONSTRUCTION AND MAINTENANCE

39. Testing of Liner Materials: Appendices E, F and G of Appendix 7 need to be revised include testing the liner materials in a shear box to verify the internal and interface friction angles for the materials are sufficient to meet the factor of safety required for the design.

40. Specification 01010 Summary of Work; Section 1.3.B.2. Principal Work Items to be Performed by Contractor: This subsection does not include the placement of the soil layer directly below the primary geomembrane liner. It also will need to be revised to include installation of the geotextile this reviewer recommends be placed between the gravel capillary break layer and the GCL bedding layer.

Stormwater Control

41. Specification 02150, Stormwater Control During Construction; Section 3.2 Groundwater Control: Groundwater in the area of the proposed containment cell may be contaminated with hazardous constituents from other sites in the area such as Site G. Therefore, this subsection needs to specify that collected groundwater will be tested to determine if it contains hazardous constituents, and/or is a hazardous waste. In addition, because it is not acceptable to manage contaminated groundwater the same way as uncontaminated stormwater, Specification 02150 needs to include procedures for handling groundwater that is determined to be contaminated with hazardous constituents.

Earthwork

42. Specification 02200, Earthwork, Section 2.3 Fill Material, and Section 3.6, Placement: These specifications need to be revised to address the following comments:

   a. Specification 02200 needs to include separate specifications for the bedding layer that will be placed under the GCL. The same specifications need to be applied to the soil layers under GCLs in the bottom, sides and cover systems because the goal of providing an adequate base for the GCL, and the rest of the liner system, is the same in each case.

[Note: Specification 02200 currently does not include/address the layer under the GCL in the cover system.]

b. In the case of the Compacted Fill, the top 1+ foot on the inside of the berm needs to meet the specification for the GCL bedding layer since this is the soil that will be in contact with the GCL. For the layers under the GCL in bottom liner and the cover system, the entire depth of these layers needs to meet the specification for the GCL bedding layer identified below.

c. It is not acceptable to simply specify the soil types for the subgrade layers under a GCL as proposed in Section 2.3. The gradation of the soil, density, and moisture content all need to be specified (possibly in Section 3.6) in order to insure the soil will provide an adequate bedding layer for the GCL.

d. As stated earlier in the comments on Section 4.1.1 regarding the subgrade under the GCL, the subgrade needs to be constructed of a soil that will provide a firm bedding layer that will be rolled smooth. In addition, this bedding layer must be able to retain these characteristics throughout the construction process. Therefore, it is recommended that the bedding layer under all GCLs be constructed of soil with:
   i. 100% of the particles having a maximum dimension not greater than 2 inches,
   ii. Not more than 10% of the particles, by weight, having a dimension greater than 0.75 inches,
   iii. Not less than 50% of the particles, by weight, passing through the 200 mesh sieve, and
   iv. Not less than 25% of the particles, by weight, having a maximum dimension not greater than 0.002 millimeters.

   The bedding layer under a GCL needs to be compacted to at least 95% of the Standard Proctor Density using ASTM D-689, have a moisture content at or wet of optimum, and be smooth rolled so that there are no sharp edges or protruding objects in the surface.

   All of these specifications need to be included in Specification 02200.

43. Specification 02200, Earthwork, Section 2.3 Fill Material: The specifications for Protective Fill need to be revised to specify the protective fill in contact with the GCL shall not contain dirt clods greater than 2 inches.

44. Specification 02200, Earthwork, Section 2.3 Fill Material: The specifications for each soil layer in the bottom, side, and cover systems need to refer back to the cross section details that describe the relative locations of these layers (e.g. Figures 4-1, 4-2, and 5-2). In addition, the specifications (and the CQAP in Appendix G) need to indicate that the thicknesses shown in the figures are the **compacted** thicknesses of the layer.

45. Comments on Specification 02200, Earthwork, Section 2.4, Equipment: This section needs to include specifications for the equipment used to smooth roll the soil used for the GCL subgrade.

46. Specification 02200, Earthwork, Section 3.6, Placement: This section needs to be revised to address the following comments:

    a. Section 3.6.A.4. states that "differences in elevation for materials placed and compacted shall not exceed four feet . . ." Since material should not be placed in lifts in excess of eight (8) inches, this 4 foot difference seems excessive. The basis for a four (4) foot difference needs to be provided, and the specification revised as necessary to clarify its intent.

    b. Section 3.6.B.9. states lift thickness shall be controlled by the contractor through the use of grade stacks. This by itself is not adequate. The maximum depth of a loose lift needs to be specified in the specification. In general, the maximum depth of a loose lift should not be greater than eight (8) inches.

    c. Section 3.6.C.8 states the density of the tracked in place soil shall be no less than 90% of the maximum Standard Proctor dry density. However, other parts of the document state this layer will not be compacted. The portions of the Design Report that discuss this soil layer need to be revised as necessary to insure the document is consistent.

47. Specification 02200, Earthwork, Section 3.10, Quality Control: Item A.10 requires data to be sealed by a Florida registered P.E. The section needs to be revised to reference an Illinois registered P.E. In addition, URS/Monsanto/Solutia need to review the entire document to insure references to Florida requirements are removed from the document.

Sediment Material Handling

48. Specification 02225, Sediment Material Handling, Section 3.3, Placing and Spreading Sediments: This specification needs to state that sediments will not be placed in the cell from the top of the berms and/or pushed down the side slopes. This type of filling procedure should be avoided because it can damage the side slope liner system. Sediments (wastes) should only be placed on the bottom of the landfill and pushed toward the side slopes.

Geogrid

49. Specification 02227, Geogrid Reinforcement, Section 2.3, Geogrid: The used of "Geogrids" is not identified in the Figures provided in the Design Report. Details of how and where they will be used on the access ramp and cover need to be provided with the Figures in the Design Report.

Geomembrane

50. Specification 02244, Geomembrane: The Installation Panel Layout Drawing referenced in Specification 02244 that identifies the placement of the geomembrane panels needs to be provided as part of Design Report.

51. Specification 02244, Geomembrane: Specification 02244 needs to be revised to indicate that the HDPE geomembrane will be tested to verify it meets the minimum values for all of the parameters using the test methods and at the frequencies specified in the GRI standard GM13 (Rev. 3, June 28, 2000). Table 1(a) from GM13 that specifies the properties, test methods, minimum values, and frequencies is included as an attachment to these comments. **Note**: The values listed in the tables of GM13 are to be interpreted according to the designated test method. In this respect they are neither minimum average roll values (MARV) nor maximum average roll values (MaxARV).

52. Specification 02244, Geomembrane, Section 2.4, Field Seams: Section 2.4 needs to specify that seams will be welded by double tracked fusion welding machines whenever possible. Corners, butt seams and long repairs need to be fusion welded where possible. Extrusion or fusion welding should be used for all other repairs, detail work and patches.

53. Specification 02244, Geomembrane, Section 3.4, Deployment: Section 3.4 needs to specify that geomembrane panels will be deployed on the side slopes the same way the GCL is required to be deployed in Specification 02245, by rolling them down the slope in a controlled manner. Geomembrane panels should not be pulled up the slopes.

GCL

54. Specification 02245, GCL, Section 1.4 Delivery, Storage & Handling: It is recommended that section 1.4 of Specification 002245 be revised to require rolls of GCL to be stored off the ground on pallets from the time of delivery until they are installed.

55. Specification 02245, GCL, Section 2.1 Materials: If a "lock-stitched" GCL is the same as one that is "needle-punched," the wording of this specification should be revised to reference a "needle-punched" GCL. If it is different, a copy of the manufacture's product data sheet that describes the process of creating a lock-stitched GCL needs to be provided.

56. Specification 02245, GCL, Section 2.1 Materials: Table 1 needs to be revised to add the QC properties, tests methods, and testing frequencies specified in ASTM D-5889; "Standard Practice for Quality Control of Geosynthetic Clay Liners." The minimum value for each of these additional properties also needs to be provided in the table.

57. Specification 02245, Section 2.1 Materials: The minimum internal friction angle for hydrated GCL on a slope is identified as 6°. This is less than the interface friction angles above and below the GCL. The specification for the minimum internal friction angle for the GCL should be revised (increased), or additional information provided to justify this proposed minimum value (see earlier comments on Section 4.4.2, GCL Strength).

58. Specification 02245, GCL, Section 3.3 Installation: The specifications for overlaps of GCL panels need to state that the panels should be overlapped/layered in such a way that any liquid will run from one panel to the top of the next, rather than underneath it.

59. Specification 02245, GCL, Section 3.4 Anchor Trench: The Figures/details of the liner system show the ends of the liner system laid out horizontally in the berm, not in an anchor trench. The application needs to be revised to consistently identify how the liner system will be anchored. It is recommended that an anchor trench be used to hold the liner system in place.

60. Specification 02245, GCL: This specification does not include a section on Quality Control.

Geonet

61. Specification 02246, Geonet, Section 2.1: The table of geonet properties needs to be revised to include transmissivity, the test method used to measure this parameter, and the minimum acceptable value. The frequencies for testing each property should also be added to the table.

Seeding

62. Specification 02932, Seeding, Section 2.1 Seed Mixture: This section specifies the use of Pensacola Bahia seed and Bermuda grass seed on the cover of the landfill. It is questionable whether these types of grasses are acceptable for use in Illinois. The vegetation specifications for this site should required the seed mixture to conform to Illinois DOT Section 624.07 Seed Mixture Class 1 specifications, and include seeds such as Kentucky Bluegrass, Perennial Ryegrass, Red Top or Creeping Red Fescue, and Ladino or White Dutch Clover.

Gas Venting System

63. Gas Venting System: Appendix E and Appendix F do not appear to include any specifications for the materials used to vent gasses from the landfill, or the procedures to install these devices through the cover system.

CONSTRUCTION QUALITY CONTROL PROGRAM:

64. CQA Sampling: Because this landfill will be used to hold fairly high concentrations of PCBs, organic wastes, and heavy metals, it is very important that it is properly constructed. Therefore, in addition to the confirmation samples collected, analyzed and interpreted by the Construction Manager, the CQA consultant should be responsible for collecting and interpreting his or her own samples from the soils and liner materials used to construct the landfill.

65. Quality Control or Quality Assurance: The Construction Quality Assurance Programs, and the Specifications to some extent, need to be revised to better define the rolls of the Construction Manager and CQA Consultant:

    a. An organizational chart that graphically describes how construction of the project will be organized needs to be provided.

    b. The CQA Manuals (Appendix E, Section 1.3.1.1 and Appendix G, Section 2.3.1.1) state that the Construction Manager is responsible for the organization and implementation of the quality assurance activities for the project. Thus it appears the Construction Manager is responsible for the CQA officer's duties.

    c. Several sections within the specifications in Appendix E refer to quality assurance and/or quality evaluation. For example, Geonets, Specification 02246 includes sections titled Quality Assurance, Quality Control, and Material Quality Evaluation. As the Construction Manager is responsible for compliance with the requirements in the specification, it appears that the Construction Manager may also be performing Quality Assurance. The wording in the specifications needs to be revised where necessary to clearly state that the Construction Manager only performs Quality Control, not Quality Assurance.

CQAP Installation of Geosynthetic Components Appendix F

66. CQA Manual, Geosynthetics, Appendix F: The CQA Manual for installation of geosynthetic components needs to be revised to reflect earlier comments that have been made regarding the specifications and the properties of the geosynthetic components in the liner systems.

67. CQA Manual, Geosynthetics, Appendix F: The CQA Manual for installation of geosynthetic components needs to be revised to include a section on GCLs.

68. CQA Manual, Geosynthetics, Appendix F: It is recommended that an individual table be created for each geosynthetic component that lists the properties, test name and test method number, test frequency and the acceptable minimum/maximum values for each property.

69. CQA for Subgrade under Geomembranes: Section 2.3 Subgrade Preparation needs to specify quantifiable values for the subgrade. At a minimum, these need to include density, moisture content, maximum depth/height of ruts in the subgrade, and the size of rocks or sharp objects allowed in the top 6 inches of the soil below the geomembrane that are identified in the Specifications.

70. CQA for Geomembranes relative to GCLs: Section 2.4.4, Method of Deployment needs to be revised to reflect the following comments regarding the placement of geomembrane on a GCL:

    a. Section 2.4.4 needs to specify the method used to deploy the geomembrane will not damage the GCL under the geomembrane (e.g. the heavy equipment used to install the geomembrane will not drive on the GCL, and the geomembrane will be rolled down the side slopes rather than dragged up them).

b. Deployment (and welding) of geomembrane panels needs to be tied to installation of the GCL panels under the geomembrane. Specifically, the geomembrane needs to be installed the same day that the GCL panels directly under it are installed.

c. The geomembrane needs to be covered with 6 inches of material before the GCL under it has time to become fully hydrated. When possible, the weight of 6 inches of material should be placed on the GCL the same day the GCL panel is installed. The CQA manual should refer to the calculations (required by these comments) that provide an estimate of the time it will take the GCL to become fully hydrated once it is installed.

71. Wrinkles in Geomembranes: Both Section 2.4.4, Method of Deployment, and Section 2.8.5, Large Wrinkles need to be revised to address the following comments on wrinkles in geomembranes:

a. Section 2.4.4 needs to identify a specific, measurable the size of a wrinkle in the geomembrane that is considered unacceptable. Both the width and height need to be specified. Section 2.4.4 needs to state that if a wrinkle is taller than it is wide, or is higher than 3 inches above the subgrade, the geomembrane panel should be readjusted to smooth out the wrinkle before it is welded to the next panel.

b. There should not be any wrinkles in the geomembrane that is placed on top of the GCL since they can result in uneven pressures on the GCL. This can damage the integrity of the GCL by causing bentonite migration and an increase in the permeability of the GCL.

c. CQA at the site needs to be capable of insuring that installation process does not result in a wrinkle that is 12 inches high. Section 2.8.5 needs to be revised to reflect that a wrinkle taller than it is wide, or higher than 3 inches above the subgrade, will be repaired.

72. Seaming Geomembranes: Section 2.5.2, Acceptable Seaming Methods: As noted in the comments on the Specifications for geomembranes, this section needs to specify that the CQA consultant is responsible for insuring the use of extrusion welds will be minimized.

73. Conformance Testing for Geonets: Transmissivity should be included as a conformance test in Section 4.2.

CQAP Installation of Soil Components Appendix G

74. CQA Manual, Soil Components, Appendix G: The CQA Manual for installation of soil components needs to be revised to include earlier comments regarding the specifications and properties of the soil components in the liner systems. For example, Section 4.2.3 Soil Selection Criteria needs to include a subsection for the bedding layer under the GCL, and additional criteria such as specifications for the grain size distributions need to be provided for the various types of fills.

75. CQA Manual, Soil Components, Appendix G: It is recommended that an individual table be created for each soil component that lists the properties, test name and test method number, test frequency and the acceptable minimum/maximum values for each property.

76. CQA Manual, Soil Components, Appendix G, Section 4.2.3: The Soil Selection Criteria for each soil component needs to include measurement of the thickness of each soil component.

77. CQA Manual, Soil Components, Appendix G, Section 4.2.4: The design report needs to identify the sources of the borrow soils on a scale drawing. It also needs to describe how these areas have been used in the past (e.g. agricultural, industrial, residential, etc.).

78. CQA Manual, Soil Components, Appendix G, Section 4.2.4: The section titled Earth Fill Material Management needs to identify the parameters, test methods and testing frequencies for which the borrow soils will be analyzed. The minimum number of parameters and test frequencies for evaluating borrow sources are provided in Tables 2-2 and 2-3 of the USEPA Technical Guidance Document titled Quality Assurance and Quality Control for Waste Management Facilities (EPA/600/R-93/182, September 1993). If there is evidence, or it is suspected, that the source area may be contaminated with hazardous constituents, it may be necessary to perform additional tests in order to determine if the soils contain contaminants.

79. CQA Manual, Soil Components, Appendix G, Section 4.3.3: The design report needs to clarify which component in the landfill design it considers the Low Permeability Fill.

80. CQA Manual, Soil Components, Appendix G, Section 4.3.4: The evaluation of layer bonding states that test pits may be used (emphasis added). This section needs to specify the minimum number of test pits per lift per acre that will be used to evaluate the bonding of two lifts.

81. Test Fill / Construction Proofing Ramp: It is recommended that a test pad be used to evaluate the bonding between the lifts prior to construction of the containment cell. The procedures for constructing and evaluating a test pad are provided in Section 2.10 of the USEPA Technical Guidance Document titled Quality Assurance and Quality Control for Waste Management Facilities (EPA/600/R-93/182, September 1993). **Note**: This same procedure can also be used to evaluate the soils proposed for use as the bedding layer below the GCL component of the liner.

MAINTENANCE PROCEDURES FOR LEACHATE COLLECTION & DETECTION SYSTEMS

82. Maintenance Procedures for Leachate Collection and Detection Systems: Maintenance of the leachate collection and detection systems needs to be considered when these systems are designed. Therefore, the Design Report needs to describe the anticipated maintenance activities that will be used to assure proper operation of the leachate collection/detection systems throughout the landfill's expected life, and describe how the design of these systems

incorporates these maintenance activities. In addition, Exhibit 2 of the UAO included this item as a requirement in the Design Report.

LINER REPAIRS DURING OPERATION

83. Liner Repairs During Operation: The Design Report needs to describe the methods that will be used to repair any damage to the liner, which occurs while the landfill is in operation during placement of the waste (e.g. a dozer ripping the liner). This description needs to address all layers in the liner system.

RUN-OFF CONTROL SYSTEMS

84. Run-Off Control Systems, Section 5.5: The design of the landfill needs include a run-off control system that is capable of holding the stormwater from a 25 year 24 hour storm after the unit is closed. It is not acceptable discharge the run-off from the closed landfill directly to Dead Creek. A run-off control system for the closed landfill will prevents sediments from washing off of the landfill and into the restored Dead Creek. Also, if the cover system fails, and the run-off becomes contaminated, the run-off control system will prevent the contaminated run-off, sediments and wastes, from entering and contaminating the restored Dead Creek. The description of the run-off control system needs to include the following:

   a. Design and Performance: Describe the run-off collection and control system design. Provide calculations demonstrating that the system has sufficient capacity to collect and hold the total run-off volume. Provide a plan view showing the locations of the run-off control system components, along with sufficient drawing details and cross sections. Indicate the fate of the collected run-off.

   b. Calculation of Peak Flow: Identify the total run-off volume expected to result from at least a 24-hour, 25-year storm. Describe data sources and methods used to make the peak flow calculation. Provide copies of the calculations and data, including appropriate references.

   c. Management of Collection and Holding Units: Describe how collection and holding facilities associated with run-on and run-off control systems will be emptied or otherwise managed expeditiously after storms to maintain system design capacity. Describe the fate of liquids discharged from these systems.

   d. Construction: Provide detailed construction and material specifications for the run-off control systems. Include descriptions of the construction quality control program that will be utilized to assure that construction is in accordance with design requirements.

   e. Maintenance: Describe any maintenance activities required to assure continued proper operation of the run-off control systems throughout the active life of the unit.

Calculation of Peak Flow:

85. Peak Flow and Design of Drainage Control Structures: The calculations in Appendix D need to be revised to address the following comments regarding the stormwater calculations:

   a. The first page of the stormwater control calculations refer to a peak flow of 16 cfs, but then use 8 cfs to calculate depth of flow and velocity. The QTR-55 computer model in indicates the peak flow for a 25 year 24 hour storm is 11 cfs. Therefore, the design calculations should use at least 11 cfs for the flow.

   b. The design of the down chute uses a depth of flow of 0.38 inches when the depth of flow in the drainage swale upstream from the chute is indicated to be 0.58 inches. The calculations need to identify how the depth of flow in the down chute was determined.

   c. The calculations for sheet flow use the amount of rainfall from a 2 year 24 hour storm. This is not acceptable. The design needs to be based on the rainfall from a 25 year 24 hour storm.

CLOSURE AND POST-CLOSURE REQUIREMENTS

86. Section 5.4 Cover System Design: As noted in earlier comments regarding the Specifications and liner materials, the cover system design needs address the following comments:

   a. The common name, species and variety of the proposed cover crop needs to be provided.

   b. Descriptions of GCL and synthetic liner components including chemical properties, strength, thickness and manufacturer's specifications.

   c. It is not acceptable to use sand as a bedding layer under the GCL component in the cover system. See earlier comment on bedding layer requirements for a GCL in the bottom liner.

POST-CLOSURE REQUIREMENTS

87. Post-Closure Requirements: If the Post-Closure Requirements will be addressed in the O & M Plan, the Design Report needs to state this. Otherwise, they need to be included in the Design Report since they were included in Exhibit 2 of the UAO.

END OF COMMENTS